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Accuracy of Video Imaging Program in Predicting Skeletal Outcomes for Functional Appliances

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Abstract

Aims: The objective of this study is to evaluate the accuracy of a video imaging program (Dolphin 11.0) in predicting skeletal outcomes in patients with skeletal Class II malocclusion. *Methods and Material:* The study sample consisted of 5 young adolescents (mean age 11 years) who had undergone functional appliance therapy that included twin block appliance therapy to correct skeletal class II malocclusion. All the patients had lateral cephalograms and profile photographs taken before treatment and after completion of functional therapy. The computer-generated prediction and the actual post functional image was compared and the accuracy of this computer - generated prediction was evaluated. *Statistical analysis used:* Mean error and Standard deviation. *Results:* The computer software is showing an error of -1.48 ± 1.33 mm in predicting growth and their is mean error of 5.02 ± 3.18 mm in predicting Lower anterior facial height . The software is under – estimating the mandibular angle. *Conclusions:* The computer software based predictions were good for patient's education and communication. Efforts are needed to improve the accuracy of the system for assessment of growth changes following functional appliance therapy.

Keywords: Predictions; Visual Treatment Objective; Dolphin Imaging; Functional Appliances; Class II Malocclusions; Twin Block Appliance.

Introduction

Improvement in facial appearance is primary concern of orthodontic treatment especially when a patient presents with dentofacial deformities like Class II or Class III skeletal malocclusion. It is hard for the public to imagine the change in facial appearance without a visual reference[1,2].

In this manner , visualized treatment objectives (VTO) are important predictive tools to interpret the patient's perspectives of esthetics and to give an acceptable preview of the result. Furthermore, these VTOs facilitate the communication between the treatment team and the patient as well as provide guidance to the desired result .

Various treatment modalities have been adopted for patients with dentofacial deformities like growth modification appliances, orthognathic surgeries , camouflage fixed orthodontic therapy. Treatment rendered depends upon various factors like age of the patient, growth status of the patient , compliance and perception and motivation towards the treatment.

During growing years growth modification appliances are the preferred treatment for these patients and often accomplished facial changes after treatment are predicted using Visual treatment objective in cases of skeletal Class II malocclusion.

With the development of computer science, cephalometric landmarks were able to be digitized into the computer and the repositioning of the jaw can now be viewed immediately on the screen. The predicted outline of the post treatment facial profile is generated by specialized computer software [3,4].

So, the objective of this study is to evaluate the accuracy of a video imaging program (Dolphin 11.0) in predicting treatment outcomes in patients with skeletal Class II malocclusion who underwent functional appliance therapy with twin block appliance.

Subjects and Methods

The sample consisted of 5 patients who met the

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following criteria: children younger than 14 years (average age , 12 years ; age range , 12 to 14 years), underwent functional appliance therapy i.e twin block appliance to correct mandibular retrognathism and no congenital craniofacial deformities or trauma.

The diagnostic records included the lateral cephalometric radiographs and profile photographs before treatment and after completion of functional appliance therapy. The head films and photographs were acquired in the natural head position with teeth in centric occlusion and relaxed lip posture. There were no intraoral fixed orthodontic appliances shown in both the head films and photographs. All of the patients were treated in the department of orthodontics, Sri Hasanamba Dental College and Hospital, Hassan, Karnataka.

Both before and after cephalograms were traced on the acetate papers. All the cephalometric tracings and profile photographs were entered in a computer (Windows XP) through a scanner (HP scanjet) for analysis. The Dolphin Imaging system software (Version 11; Dolphin Imaging) was used to store and generate image prediction as shown in figure 1.

From the digitized pretreatment tracing, prediction was done using the advancement of mandible as indicated for a particular case. The Dolphin software (Version 11) uses Bolton's growth analysis as one of the method for assessing growth. Since average total treatment time taken for the functional appliance therapy was 2 years, so same amount of growth was incorporated in the prediction Tracing using Bolton's growth analysis. Then the predicted Dolphin tracings and post functional tracings were compared using cephalometric measurements.

Method of Prediction

After completion of Phase I the predicted outcomes and actual treatment outcomes were compared cephalometrically and photographically (Profile view) as shown in Figure 2.

Various Parameters like position of maxillary and mandibular bases (SNA , SNB), ANB angle, Lower anterior facial height (LAFH), mandibular plane angle (MPA) and mandibular lengths were evaluated.

Results

All the Parameters (measured position of maxillary and mandibular bases, ANB angle , Lower anterior facial height, mandibular plane angle and mandibular lengths) were measured for all the selected patients. A mean error and standard deviation was then calculated between the predicted and the actual treatment outcomes (Table 1) .

The computer software is showing an mean error of -1.48 ± 1.33mm in predicting growth. As error in growth has been determined so there is mean error of 5.02 ± 3.18 mm in predicting lower anterior facial height (LAFH). The software is under–estimating the mandibular angle.

There is an increase of SNA angle in prediction as compared to actual treatment outcome due to reactive force on maxilla in functional appliances. Software prediction is more in anteroposterior plane.

Table 1: Showing mean error between predicted and actual treatment outcome

S. No.	Parameters	Mean ± S.D	Significance
1.	SNA(degree)	2.26± 0.82°	NS*
2.	SNB (degree)	1.62 ± 1.2°	NS
3.	ANB (degree)	0.08 ± 1.16 °	NS
4.	LAFH(milimetres)	-5.02 ± 3.18 mm	NS
5.	MPA (degree)	-1.46 ± 4.2 °	NS
6.	Maxillary length (Co – A) (milimetres)	3.16 ± 2.51 mm	NS
7.	Mandibular length (Co – Gn) (milimetres)	-4.3 ± 1.38 mm	NS
8.	Anterior cranial base(Se – N) (milimetres)	-1.48 ± 1.33 mm	NS

(*NS - Not significant)

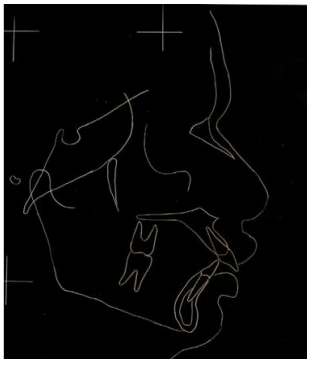

Fig. 1: Pretreatment digitized cephalogram

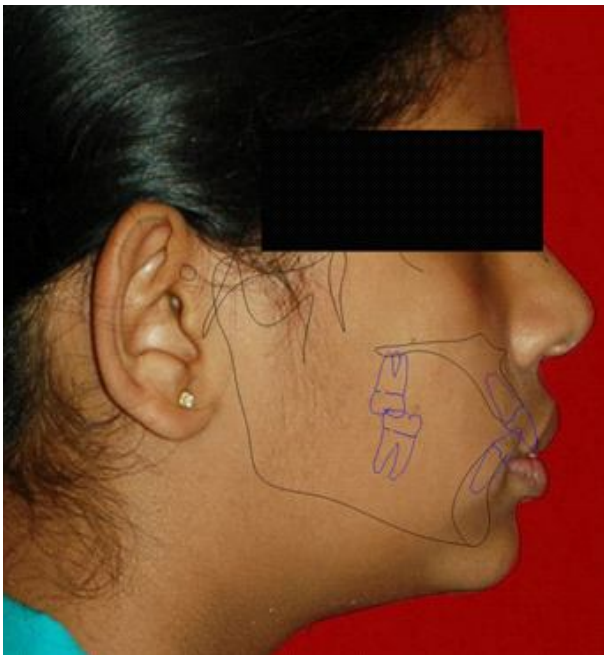

Fig. 2a: Patient profile photograph with superimposed digitized cephalometric structures

Fig. 2b: Predicted patient profile image using dolphin software (mandible was advanced)

Fig. 3a: Comparison of software predicted image with post treatment profile photograph

Discussion

Patients with Class II malocclusions have some sort of skeletal imbalance. Because Class II malocclusion becomes apparent early in the mixed dentition, the possibility of growth modification and the optimal timing for treatment are both questions of considerable clinical interest. Given a young patient with a noticeable overjet, the choices are early treatment to modify jaw growth, later treatment to camouflage the jaw discrepancy through tooth movement , or for the most severe, surgical correction of the skeletal relationship. Although the goals of each approach are the same, namely, to improve facial and dental appearance, maintain or enhance the oral health, and establish a stable and functional occlusion, the treatment approaches are very different [7].

Growth modification using a functional appliance remains a problem as Bishara [8] suggested that the success of a functional appliance is totally dependent on cooperation.

Bondevik [6] attempted to identify factors that influenced successful functional appliance treatment outcome by comparing satisfactory and unsatisfactory activator results. Cooperation, skeletal maturation, age, and sex were the variables considered and from these he found that cooperation was the only variable suitable for predicting the treatment outcome, good cooperation was associated with a satisfactory result [6].

As with any treatment method, patient compliance is largely outside the control of the orthodontist. To

achieve good patient cooperation, patient motivation is of utmost importance which can be obtained by educating patients about the treatment .

In certain cases where skeletal malocclusion is worsened by dental malformations especially in cases where teeth are severely rotated. This study is to obtain a treatment outcome using a computerized software. Additionally an attempt was made to compare the treatment outcomes with the predicted outcomes.

Various studies have shown headgear effect on maxilla during functional appliance therapy but in this study there is an increase in SNA angle as biomechanics of functional appliances cannot be predicted by computer software.

There is an increase in length of cranial base ie. (Se - N) which indicates that software is able to predict growth .

There is an increase in mandibular plane angle due to downward and forward growth of mandible but software is under estimating the measurement of mandibular plane angle .

Measured mandibular and maxillary lengths are also statistically insignificant as software predictions are more as compared to actual treatment outcomes which indicates that software is showing more predictions in anteroposterior plane than in vertical plane .

Lip contouring can be done in the prediction profile which gives a more accurate view of post-treatment patient profiles as shown in figure 3(a). In this figure lip strain is eliminated in post-treatment profile as well as in predicted image which was present in the pre - treatment patient profile.

The present era is a digital era, so the current study was performed with the aim of using digital softwares and to check their accuracy in predicting the outcomes of functional appliance therapy as compared to that of manual predictions. In this study, there were no statistically significant differences in the predicted errors. However, in our study, the sample size was relatively smaller. Hence the clinical significance needs to be further investigated .

Conclusion

The computer software based predictions were good for patient's education and communication. Dolphin software predictions are more accurate for surgical predictions than functional appliances. Efforts are needed to improve the accuracy of the system for assessment of growth changes following functional appliance therapy.

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